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Schaumburg Thoenes Thurn Landskron
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5 Inventor: Jenak et al.

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CLEANING UNIT FOR CLEANING A CONVEYOR BELT

The present invention concerns a cleaning unit and a method for cleaning a transport belt for transport of recording media in the transfer printing region of an electrographic printing or copying device, as well as an abrasion element and a capture reservoir for such a cleaning unit.

In electrographic printers or copiers, the transfer of a toner image from an intermediate carrier (for example a photoconductor drum or a photoconductor ribbon) onto a recording medium is designated as transfer printing. The section of the printing or copying device at which the intermediate carrier and the recording medium are brought into contact with one another is designated as a transfer printing region. In the transfer printing region, the intermediate carrier (meaning, for example, the generated surface of a photoconductor drum) and the recording medium move in the same direction with the same speed while the toner is transferred from the intermediate carrier onto the recording medium. A print image of high quality can only be achieved on the recording medium when a uniform contact between recording medium and intermediate carrier is produced in the transfer printing region and when the recording medium and the intermediate carrier actually move with exactly the same speed in the transfer printing region.

In order to ensure this, transport belts are proposed on which the recording media (for example electrostatically adhering) are transported through the transfer printing region. With such a transport belt, the transport speed of the recording medium in the transfer printing region can be predetermined exactly and without interference and a uniform arrangement of the recording medium on the intermediate carrier can be achieved.

Since the transport belt moves through the transfer printing region, it can easily be contaminated with toner. When, for example, individual paper sheets are used as recording media, toner can arrive on the intermediate regions between successive

5 sheets and in the boundary regions outside of the paper dimension. In the event that the recording medium is printed on both sides, toner can moreover loosen from an already-printed side with which the recording medium lies on the transport belt and contaminate this. A transport belt contaminated with toner in turn contaminates subsequent recording media, which is not acceptable.

10 A cleaning unit is known from DE 198 31 786 A1 that has an abrasion element (arranged transverse to the running direction of the transport belt and lying on this) that is set to abrade toner located on a transport belt and that has a toner capture reservoir for capture of the abraded toner.

15 An abrasion element for a photoconductor drum is known from JP 03-200191. The abrasion element is comprised of a synthetic rubber that is admixed with 1 weight percent aluminum oxide as a polishing agent. A further abrasion element for a photoconductor drum is known from EP 0 691 594 A1. Rubber, plastic, metal and ceramic are cited therein as materials for the abrasion element. The material rubber is thereby preferred.

20 A cleaning unit with a mounting device for an abrasion element that is rotatable by 180° is known from EP 0 546 751 A2. Various edges of the abrasion element can thereby be used for cleaning. Toner capture reservoirs are disclosed in US 4,730,205, US 6,405,016 B1, US 5,581,342, US 4,500,196 and US 5,383,011.

25 The present invention is based on the object to specify a cleaning unit for cleaning of a transport belt of the previously cited type, with which the transport belt can be thoroughly cleaned of toner.

30 This object is achieved according to claim 1 via a cleaning unit that has an abrasion element (said abrasion element arranged transverse to the running direction of the transport belt and lying on this) that is set to abrade toner located on the transport

belt and a toner capture reservoir to capture the abraded toner. Advantageous developments are specified in the further claims.

5 In tests, the use of very hard materials for the abrasion element has proven to be advantageous, both concerning the thoroughness of the cleaning and the wear of the transport belt and of the abrasion element itself. Abrasion elements made from ceramic, whose wear was by far less (due to their hardness) than, for example, that of a likewise tested abrasion element made of spring steel, have proven to be particularly advantageous. In a particularly advantageous embodiment, the
10 abrasion element is made from an aluminum oxide ceramic that represents a very good compromise between high wear durability and advantageous production costs.

15 In the production of the ceramic it is advantageous to grind the initial materials to a grain size that is smaller than or equal to that of the toner particles. In the event that individual grains loosen from the ceramic abrasion element, the cavities created are small enough that no toner particles pass through them and therefore possibly remain on the transport belt in spite of the cleaning unit.

In an advantageous development of the present invention, the abrasion element is designed as a cuboid-shaped abrasion bar. The cleaning unit also preferably has a mounting device in which the abrasion bar can be used in four different positions, whereby the four positions differ from one another by a rotation of the abrasion bar by respectively 180° around its longitudinal axis and/or its transverse axis. Via these four positions, all four longitudinal edges of the abrasion bar can be used in succession for abrasion of the toner, which quadruples the lifespan of the abrasion bar.

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In order to conserve the longitudinal edges, the mounting preferably has recesses that prevent a contact of the longitudinal edges of the abrasion bar with the mounting. Longitudinal edges of the abrasion bar not yet used for abrasion thus remain sharp.

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The mounting preferably has a receptacle in which the abrasion bar is inserted with positive fit and a clamping plate with which the abrasion bar is clamped fast in the receptacle. The change of the position of the abrasion bar in the mounting device can thereby be implemented simply and quickly. In particular the alignment of the abrasion bar with regard to the transport belt thereby does not have to be readjusted, since the abrasion bar is placed in the mounting with positive fit and therefore in explicit position and the position of the mounting does not vary upon changing the position of the abrasion bar.

25 A flexible support element for the transport belt is preferably provided on the side of the transport belt opposite the abrasion element. The transport belt can then be pressed against the flexible support element by the abrasion element, whereby a consistent contact results between transport belt and abrasion element.

30 The support element preferably comprises a felt lying on the transport belt. Such a felt offers a sufficient flexibility and at the same time serves to clean the side of the

transport belt facing away from the abrasion element. In an advantageous development, the felt is arranged with positive fit in a metal receptacle. It is thereby prevented that the felt is loosened or shifted by the transport belt.

5 As mentioned above, the inventive cleaning unit comprises a toner capture reservoir to capture the abraded toner. The captured toner can, for example, be transported with a screw transport from the toner capture reservoir into a waste toner reservoir present anyways in an electrographic printer or copier. The transport device necessary for this for the captured toner into [sic] the waste toner
10 reservoir present anyway is, however, relatively elaborate and costly. Therefore, in the present invention such a transport is foregone and instead of this the capture reservoir is designed such that it can be removed from the printing or copying device. The capture reservoir thus simultaneously serves as an independent waste toner reservoir.

15 The toner capture reservoir can be sealed in the printer or copying device. Upon removal of the capture reservoir from the printer or copying device, no toner can then be spilled.

20 In a preferred development, the toner capture reservoir is electrically conductive. The toner (normally electrostatically charged) can thereby be discharged in the toner capture reservoir and does not tend to accumulate at components located in the environment of the capture reservoir and charged opposite to the toner.

25 When the toner conveyance system is simultaneously used as a waste reservoir, it is important that it can be produced particularly cost-effectively. The toner capture reservoir is preferably comprised of plastic that can be cost-effectively processed. The toner capture reservoir is thereby preferably produced in a vacuum deep-draw method which enables a small material consumption and low production costs.

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Guide grooves into which a cover to seal the toner capture reservoir can be inserted are preferably designed on the toner capture reservoir. The guide grooves are preferably formed by down-turned sections of the edge of the toner capture reservoir. The toner capture reservoir also preferably has an engagement section at
5 which the toner capture reservoir can be engaged upon its removal from the printer or copying device and that is height-displaced relative to the guide grooves, such that it undercuts the inserted cover.

Longitudinal and/or transverse ribs that prevent a flow movement of the toner in
10 the toner capture reservoir are preferably designed in the toner capture reservoir.

In a preferred development, the cleaning unit comprises a microswitch that scans whether the toner capture reservoir is correctly arranged in the printer or copier.

15 For better understanding of the present invention, in the following reference is made to preferred exemplary embodiments shown in the drawings which are described using specific terminology. However, it is noted that the protective scope of the invention should not thereby be limited, since such variations and further modifications to the shown device and the method as well as to such further
20 applications of the invention as they are shown therein are viewed as typical present or future expertise of a competent average man skilled in the art.

Figures show exemplary embodiments of the invention, namely

25 Fig. 1 a schematic representation of a cleaning unit for cleaning of a transport belt for transport of recording media in the transfer printing region of an electrographic printer,

Fig. 2 a schematic representation of the transport belt of Fig. 1 that is
30 pressed by an abrasion element against the felt of a support element,

- Fig. 3 a bottom view of the transport belt of Fig. 1 with abrasion bar lying thereon,
- Fig. 4 a plan view of the abrasion bar of Fig. 1 through 3 in its mounting,
- 5 Fig. 5 a side view of the abrasion bar of Fig. 1 through 4 in its mounting,
- Fig. 6 a section along the line A-B of Fig. 4,
- 10 Fig. 7 a perspective view of a toner capture reservoir with partially inserted cover,
- Fig. 8 a perspective view of the toner capture reservoir of Fig. 7 without cover, and
- 15 Fig. 9 an enlarged section of Fig. 8.

The transfer printing of a toner image from the generated surface 10 of a photoconductor drum 12 onto a sheet of paper 14 is schematically shown in Fig. 1.

20 The transfer of the toner from the photoconductor drum 12 onto the paper sheet 14 occurs in the transfer printing region 16, in which the generated surface 10 of the photoconductor drum 12 and the sheet 14 contact one another. The toner located on the generated surface 10 of the photoconductor drum 12 is electrostatically charged and is transferred onto the sheet 14 in a known manner with the aid of

25 electrostatic field forces.

The sheet 14 electrostatically adheres to the transport belt 18 that revolves counterclockwise with a revolution speed V_U in the representation of Fig. 1, as is indicated by corresponding speed arrows. The photoconductor drum 12 rotates

30 clockwise in the representation of Fig. 1, whereby the generated surface 10 moves with a tangential speed V_U of the transport belt 18. The exact coincidence of V_T

and V_U is a precondition of the toner image being transfer printed without distortion and without smearing.

5 In addition to the sheet 14 located in the transfer printing region 16 in Fig. 1, an already-printed sheet 20 is shown. The transport belt 18 is contaminated with toner particles 22 (schematically shown) between these two successive sheets. The toner particles 22 can, for example, have been transferred from the photoconductor drum 12 onto the transport belt 18 when this was not completely cleaned of residual toner.

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Furthermore, a cleaning unit 24 for cleaning of the transport ribbon 18 is shown in Fig. 1. The cleaning unit 24 comprises an abrasion bar 26 that is arranged transverse to the running direction of the transport belt 18, a support element 28 and a toner capture reservoir 30. The support element 28 is likewise arranged
15 transverse to the running direction of the transport belt 18 and has a flexible felt 32 that is arranged with positive fit in a metal receptacle 34.

With the transport belt 18, the abrasion bar 26 encloses an angle of 30° and, with its first longitudinal edge 36a, presses said transport belt 18 against the felt 32 of
20 the support element 28 with a pressure force F_d represented in Figure 1 by a force arrow. The pressure force F_d is generated by a spring (not shown in Fig. 1) with which the abrasion bar 26 is pressed with its first longitudinal edge 36a against the transport belt 18 such that it acts in an impinging manner counter to the belt running direction. When the transport belt passes the cleaning unit 24, toner 22
25 adhering on the transport belt remains hanging on the longitudinal edge 36a of the abrasion bar 26 and, due to gravity, falls into the toner capture reservoir 30.

The abrasion bar 26, the transport belt 18 and the felt 32 of Fig. 1 are shown in an enlarged view in Fig. 2. As is to be seen therein, due to the pressure force F_d the
30 transport belt 18 travels closely around the longitudinal edge 36a such that no toner particles 22 pass this.

In the shown exemplary embodiment, the abrasion bar 26 is comprised of an aluminum oxide ceramic and the transport belt 18 is comprised of polyvinylidenefluoride (PVDF). The combination of the very hard ceramic with the soft transport belt enables a very thorough cleaning with very low wear, both of the transport belt 18 and of the abrasion bar 26. The ceramic allows a very smooth, even and precise production of the abrasion bar, which contributes to the thoroughness of the cleaning and to the lifespan of the transport belt 18. The friction forces occurring between PVDF belt 18 and ceramic bar 26 are so slight that the belt speed is barely affected by the abrasion bar.

The surface quality of the ceramic abrasion bar 26 is tuned to the grain size of the toner. In particular, in its production the initial materials of the ceramic are milled to a grain size that is smaller or equal to that of the toner particles. When individual grains loosen from the ceramic, the cavities thereby created in the abrasion bar are so small that no toner particles 22 pass through and thus can remain on the transport belt 18.

A bottom view of the transport belt 18 and a part of the abrasion bar 26 are shown in Fig. 3. The abrasion bar 26 is arranged with positive fit in a mounting 38 and extends transverse to the running direction of the transport belt 18 over its entire width. For reasons of clarity, the mounting 38 was left out in the schematic representation of Fig. 1. The mounting 38 is set once transverse to the transport belt 18, such that a uniform pressure force F_d results over the entire width of the transport belt 18. Since the abrasion bar 26 is arranged with positive fit in the mounting 38, neither the abrasion bar 26 nor the mounting 38 have to be readjusted when the abrasion bar 26 is exchanged or, as is described in detail below, when the abrasion bar 26 is rotated around one of its axes of symmetry.

As is furthermore shown in Fig. 3, the toner 22 can adhere both to the edges of the transport belt and in a middle region of the same. It is therefore necessary to

ensure a uniform pressure force F_d over the entire width of the transport belt 18, as is the case in the shown exemplary embodiment.

5 The mounting device 38 and the abrasion bar 26 are shown in Fig. 4, 5 and 6. Fig. 4 is a plan view and Fig. 5 is a side view of the mounting device 38, which has a receptacle 40 in which the abrasion bar 26 is arranged with positive fit. As is likewise shown in Fig. 4 and 5, the abrasion bar 26 is clamped fast in the recess 40 with the aid of a clamping plate 42 that is attached to the mounting 38 in a detachable manner with the aid of a knurled screw 44.

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As is to be seen in Fig. 4 and 5, the abrasion bar 26 is cuboid-shaped. The abrasion bar can thereby be uniformly used in four different positions in the recess 40 of the mounting 38, whereby the positions differ from one another by a rotation of the abrasion bar of respectively 180° around its longitudinal axis and/or its transverse axis, thus its axes of symmetry. In each of these four positions, another of the four longitudinal edges 36a through 36d of the abrasion bar 26 comes to rest on the transport belt 18. By changing these positions, the lifespan of the abrasion bar 26 is quadrupled.

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20 A cross section along the line A-B of Fig. 4 is shown in Fig. 6. A recess 46 in the receptacle 40 of the mounting 38 is to be seen therein that extends over the entire length of the receptacle 40 and prevents a contact of the longitudinal edges of the abrasion bar 26 with the mounting 38. The longitudinal edges 36a through 36d of the abrasion bar 26 are thereby prevented from damage. Similar recesses 48 for the transverse edges of the abrasion bar 26 are likewise shown in Fig. 4.

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The toner capture reservoir 30 shown only schematically in Fig. 1 is shown in detail in Fig. 7 and 8. The toner capture reservoir 30 simultaneously serves as a waste reservoir and is therefore designed as a cost-effective disposable part that can be simply removed from the printer or copying device and replaced by a new one. The toner capture reservoir 30 is produced from plastic and in a vacuum

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deep-draw method. Its longitudinal edges 50 and its rear transverse edge 51 are recurved inwards, such that guide grooves 52 result in which a pasteboard 52 (Fig. 7) can be inserted from the front while the toner capture reservoir 30 is still located in the printer or copier such that it no toner spills upon its removal.

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Fig. 9 shows the section characterized by a dashed circular arc in Fig. 8 in enlarged representation. In Fig. 9, the guide grooves 2 are easily recognizable. The recurved edge 50 of the toner capture reservoir 30 has a section 56 drawn slanted downwards. This section exerts a light pressure on the inserted cover 54 (Fig. 7), such that this seals the toner capture reservoir tight. As is in particular to be seen in Fig. 9, the down-turned longitudinal edge 50 is canted on its end facing forwards in order to ease the insertion of the cover 54.

The toner capture reservoir 30 has an engagement section with recessed grip 60 formed therein on its forward transverse side (narrow side situated to the right in the representation of Fig. 7). A Z-shaped step 62 that undercuts the inserted cover 54 and provides for secure sealing of the toner capture reservoir 30 is formed in the engagement section 58. A longitudinal rib 64 and four transverse ribs 66 that prevent a flow movement of the toner in the toner capture reservoir 30 are formed inside the toner capture reservoir 30.

For accommodation of the toner capture reservoir 30 in the printer or copying device, rope profiles (not shown) are arranged into which the toner capture reservoir 30 is inserted at its rear end with its longitudinal edges 50 and is introduced into the device (not shown) in the direction characterized with arrow 58 in Fig. 8. A microswitch (not shown) that scans the rear transverse edge 51 or, respectively, a rear section of the longitudinal edge 50 is also located in the device. In the event that the toner capture reservoir 30 is not or is incorrectly introduced into the device or, respectively, is not inserted far enough into the device, this is detected by the microswitch and a print or copy operation is prevented.

Although preferred exemplary embodiments are shown and specified in detail in the drawings and the preceding specification, these should be viewed as purely exemplary and not as limiting the invention. It is noted in this regard that only the preferred exemplary embodiments are shown and specified, and all variations and
5 modifications should be protected that presently or in the future lie within the scope of protection of the invention.

Reference list

	10	generated surface
	12	photoconductor drum
5	14	sheet of paper
	16	transfer printing region
	18	transport belt
	20	sheet of paper
	22	toner particles
10	24	cleaning unit
	26	abrasion bar
	28	support element
	30	toner capture reservoir
	32	felt
15	34	receptacle
	36a through 36d	longitudinal edges of the abrasion bar 26
	38	mounting
	40	receptacle
	42	clamping plate
20	44	knurled screw
	46	recess
	48	recess
	50	longitudinal edge
	51	transverse edge
25	52	guide groove
	54	cover
	56	section of the longitudinal edge 50
	58	engagement section
	60	recessed grip
30	62	step
	64	longitudinal rib

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transverse rib